"**comprising bonded superabrasive grains and a portion of the tooth**" are among the plurality of cutting levels on each tooth. A copy of the claims as they presently stand is contained in Appendix A annexed hereto.

Remarks

Asada cannot be read to teach a structure having a first uppermost cutting layer consisting of bonded abrasive grain. The Asada structures shown in Figures 1 and 6 comprise grain and bond around the perimeter of the tooth, together with the tooth material itself (e.g., steel) at a 'first uppermost cutting level,' and the performance of the Asada tool (see Figure 11) bears witness to such an observation. Asada's **"prior art"** tools shown in Figures 8, 9 and 10, which Asada cautions us not to make or use (see col. 1, lines 21-43; col 2, lines 52-56 and 60-6; and col. 3, lines 38-46), do have a layer consisting of bonded abrasive grain corresponding to Applicants' claimed first uppermost cutting layer. Asada states one must remove the grain from the top surface of the tooth. Asada literally teaches away from structures described in our claims 1, 5-9, 11-26 and 30-33.

The Examiner alleges that Asada discloses "...the layer being electroplated to at least a portion of the surface of each tooth to define a plurality of cutting levels parallel to the substrate surface, and each cutting level on each tooth being oriented such that a portion of each cutting level overlaps at least a portion of each other cutting level of the tooth...". However, the Examiner does not reference a particular column and line of text in Asada where this disclosure can be found because there is no such disclosure in Asada. One cannot infer such a construction from the Figures in Asada, because Asada teaches the abrasive grain must be electroplated to the teeth. One of the well documented disadvantages of electroplated diamond tools is the ease with which the electroplated metal can be peeled away or stripped from the metal core when force is applied to the cutting diamonds physically held within the electroplated layer. In other words, one cannot assume the construction *"...each cutting level on each tooth being oriented such that a portion of each cutting level overlaps at least a portion of each other cutting level of the tooth..."* will automatically occur on ***each tooth*** of an electroplated

tool. All or some of the electroplated bond will peel off of at least some of the teeth as the tool is used. Thus, Asada does not disclose what the Examiner has alleged and obviousness cannot be obtained from a hindsight reconstruction of the reference. Applicants' claim limitations cannot be read into the Asada disclosure where they do not exist.

For convenience, Applicants repeat the following remarks submitted with the previous amendment filed on August 27, 2003.

With respect to claims 13 and 30, the Asada design fails to provide the initial high penetration cutting followed by steady state cutting conditions of the sort described in Applicants' text on page 11, lines 17-25, and Fig. 2. The Asada design cannot provide high initial cutting rate conditions because Asada has removed the first layer of abrasive grain from the top of the teeth and it is this top of the tooth grain layer that contributes the initial aggressive cut in Applicants' tools. It is not possible to achieve such an initial aggressive cut using an electroplated tool. (Compare Figure 11 of Asada to Figure 2 of Applicants' application.)

Lowder was cited as evidence of knowledge in the art of the benefits of a chemically active bond in single layer abrasive grain tools. Lowder is silent regarding tool geometry, steady state cutting rates, freedom of cut and other structural limitations and functional attributes of Applicants' claimed invention. It contains no suggestion to combine the various structural limitations of Applicants' invention with a chemically reactive bond.

Applying the standard for obviousness set forth in MPEP 706.02(j), there must be a suggestion or motive in the references or in the general knowledge in the art to modify the references or to combine the references. Second, there must be a reasonable expectation of success in making such a combination or modification. <u>Third, the art must teach or suggest all claim limitations.</u>

Here, the "first uppermost cutting level ***consisting of bonded grain***" on the teeth is completely missing from the references.

Other structural aspects of the tools of the invention are likewise absent from the combined cited references. The tooth geometry and/or the tool type shown in Applicants'

Figures 6-9 and 11-12 are neither disclosed nor suggested. In particular, the references fail to mention core drills: a tool type likely to benefit from high penetration rate and steady state cutting operations, as well as from enhanced tool life. Given the direct relationship between tool structure and performance arising from these differences between the cited prior art and the claimed invention, an obviousness rejection cannot be sustained.

Conclusion

In view of the remarks set forth herein, and the remarks of record, Applicants respectfully request a reversal of the rejection of claims 1, 5-9, 11-26 and 30-33, and an allowance of all claims pending in the application.

Respectfully submitted,

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APPENDIX A

Docket F-3278

Claims
Ser. No.: 08/892,836
Filed: 7/15/97; Skeem, et al

1. (previously presented) An abrasive cutting tool comprising:

a) a monolithic substrate having a substrate surface with a plurality of teeth extending therefrom, each tooth having a contoured surface,

b) a layer comprising superabasive grains, the layer being chemically bonded to at least a portion of the surface of each tooth to define a plurality of cutting levels parallel to the substrate surface, and each cutting level on each tooth being oriented such that a portion of each cutting level overlaps at least a portion of each other cutting level of the tooth; and

c) a first uppermost cutting level consisting of bonded superabrasive grains, and successive uppermost cutting levels, comprising bonded superabrasive grains and a portion of the tooth, among the plurality of cutting levels of each tooth;

whereby after the first uppermost cutting level has been worn away by cutting a workpiece, each successive uppermost cutting level of the tooth presents to the workpiece a ring of superabrasive grain around the contoured surface of the tooth, and substantially all superabrasive grain within the ring simultaneously engages in cutting.

3. (original) The tool of claim 1 wherein the substrate surface has an intended direction of movement, wherein at least a portion of each tooth has a face which is inclined at a negative angle with respect to the intended direction of movement, and at least a portion of the grains are bonded to the face having the negative angle of inclination.

4. (original) The tool of claim 3 wherein the grains bonded to the face having the negative angle of inclination are present in a concentration wherein the angle of inclination in degrees is no more than 1/3 of the grain concentration in percent.

5. (original) The tool of claim 1 comprising successive cutting levels comprising at least 50% of the plurality of cutting levels, wherein each cutting level of the successive cutting levels contains about the same number of grains.

6. (original) The tool of claim 1 wherein a portion of each tooth is associated with successive cutting levels comprising at least 50% of the cutting levels of the tooth, and wherein each cutting level of the successive cutting levels contains about the same number of grains.

7. (original) The tool of claim 6 wherein the portion of each tooth associated with the successive cutting levels having about the same number of grains has a constant cross section.

8. (original) The tool of claim 6 wherein the portion of each tooth associated with the successive cutting levels having about the same number of grains has an uppermost cross section and a lowermost cross section, and the uppermost cross section is smaller than the lowermost cross section.

9. (original) The tool of claim 6 wherein the successive cutting levels having about the same number of grains comprise at least the lowermost 50% of the cutting levels of each tooth.

10. (original) The tool of claim 9 wherein the substrate surface has an intended direction of movement, wherein at least the uppermost 10% of each tooth has a face which is inclined at a negative angle with respect to the intended direction of movement, and at least a portion of the grains are bonded to the face having the negative angle of inclination, thereby producing a trapezoidal cutting surface.

11. (original) The tool of claim 1 wherein the concentration of the grain is less than 75%.

12. (original) The tool of claim 1 wherein the teeth have a hardness of between about 38 and 42 Ra.

13. (previously presented) A method of cutting, comprising the steps of:

a) providing an abrasive cutting tool comprising:

i) a substrate surface having a plurality of teeth extending therefrom, each tooth having a surface, and

ii) a layer comprising abrasive grains, the layer being chemically bonded to at least a portion of the surface of each tooth to define a plurality of cutting levels parallel to the substrate surface, the cutting levels comprising a first uppermost cutting level, consisting of bonded abrasive grains, and a second uppermost cutting level, comprising bonded abrasive grains and a portion of the tooth, the grains having a predetermined wear resistance,

b) moving the substrate surface in an intended direction of rotation,

c) contacting the uppermost cutting level of at least one tooth to a workpiece at a point of contact,

d) applying a constant force to the tool directed at the point of contact,

wherein the constant force is sufficient to cut the workpiece, the strength of the bond is sufficient to resist peeling, the predetermined wear resistance of the grains is such that the grains of the first uppermost cutting level fracture under application of the constant force, and the wear resistance of the teeth are such that the portion of the tooth associated with the first uppermost cutting level wears at about the same rate as the grains of the first uppermost cutting level fracture,

thereby causing essentially simultaneous removal of the grains of the first uppermost cutting level from their bond and the portion of the tooth associated with the first uppermost cutting level, and

thereby exposing the grains of the second uppermost cutting level to the workpiece.

14. (original) The method of claim 13 wherein the plurality of teeth includes successive teeth having successively lower uppermost cutting levels in the intended direction of movement, thereby producing a cutting surface having a negative angle of inclination with respect to the intended direction of movement.

15. (original) The method of claim 13 wherein at least a portion of each tooth has a face which is inclined at a negative angle with respect to the intended direction of movement, and at least a portion of the grains are bonded to the face having the negative angle of inclination.

16. (original) The method of claim 15 wherein workpiece produces abrasive swarf when cut, and wherein the grains bonded to the face having the negative angle of inclination are present in a concentration wherein the angle of inclination in degrees is no more than 1/3 of the grain concentration in percent, thereby protecting the grains of the uppermost cutting level from undercutting.

17. (original) The method of claim 13 comprising successive cutting levels comprising at least 50% of the plurality of cutting levels, wherein each cutting level of the successive cutting levels contains about the same number of grains.

18. (original) The method of claim 17 wherein a portion of each tooth is associated with successive cutting levels comprising at least 50% of the cutting levels of the tooth, and wherein each cutting level of the successive cutting levels contains about the same number of grains.

19. (original) The method of claim 18 wherein the portion of each tooth associated with the successive cutting levels having about the same number of grains has a constant cross section.

20. (original) The method of claim 18 wherein the portion of each tooth associated with the successive cutting levels having about the same number of grains has an uppermost cross section and a lowermost cross section, and the uppermost cross section is smaller than the lowermost cross section.

21. (original) The method of claim 13 wherein the grain toughness is characterized by a relative strength index of at least one minute, as measured by the FEPA standard for measuring the relative strength of saw diamonds.

22. (original) The method of claim 13 wherein the grain size is between about 100 um and 600 um.

23. (original) The method of claim 18 wherein the successive cutting levels having about the same number of grains comprise at least the lowermost 50% of the cutting levels of each tooth.

24. (original) The method of claim 13 wherein the concentration of the grain is less than 75%.

25. (original) The method of claim 13 wherein the workpiece is masonry having a Knoop hardness of at least 700 Rc.

26. (original) The method of claim 13 wherein the teeth have a hardness of between 38 Ra and 42 Ra.

27. (withdrawn)

28. (Previously presented) An abrasive cutting tool comprising:

a) a monolithic substrate having a substrate surface with a plurality of teeth extending therefrom, each tooth having a contoured surface,

b) a layer comprising abrasive grains, the layer being chemically bonded to at least a portion of the surface of each tooth to define a plurality of cutting levels parallel to the substrate surface, and each cutting level on each tooth being oriented such that a portion of each cutting level overlaps at least a portion of each other cutting level of the tooth; and

c) a first uppermost cutting level and successive uppermost cutting levels comprising superabrasive grains among the plurality of cutting levels of each tooth; wherein the substrate surface has an intended direction of movement, wherein at least a portion of each tooth has a face which is inclined at a negative angle with respect to the intended direction of movement, and at least a portion of the abrasive grains are bonded to the face having the negative angle of inclination, and whereby after the first uppermost cutting level has been worn away by cutting a workpiece, each successive uppermost cutting level of the tooth presents to the workpiece a ring of superabrasive grain around the contoured surface of the tooth, and substantially all superabrasive grain within the ring simultaneously engages in cutting.

29. (original) The tool of claim 28 wherein at least the uppermost 10% of each tooth comprises the face which is inclined at a negative angle with respect to the intended direction of movement.

30. (previously presented) An abrasive cutting tool comprising:

a) a substrate surface having a plurality of teeth extending therefrom, the teeth having a surface and a predetermined wear resistance, and

b) a layer comprising abrasive grains, the layer being chemically bonded to at least a portion of the surface of each tooth to define a plurality of cutting levels parallel to the substrate surface, the cutting levels comprising a first uppermost cutting level consisting of bonded abrasive grains, and the grains having a predetermined wear resistance,

wherein the wear resistance of the teeth and the wear resistance of the grains are predetermined such that, when a given cutting level contacts a workpiece under an optimum load, the grains of the given cutting level wear and fracture at about the same rate as the portion of the tooth associated with the given cutting level wears away.

31. (original) The tool of claim 30 wherein the teeth have a hardness of between 38 Ra and 42 Ra.

32. (original) The tool of claim 31 wherein the grains have a relative strength index of at least one minute, as measured by the FEPA standard for determining the relative strength of saw diamonds.

33. (original) The abrasive cutting tool of claim 1, wherein the tool is selected from the group consisting of saw blades, core drills and abrasive wheels.

34. (original) The abrasive cutting tool of claim 28, wherein the tool is selected from the group consisting of saw blades, core drills and abrasive wheels.